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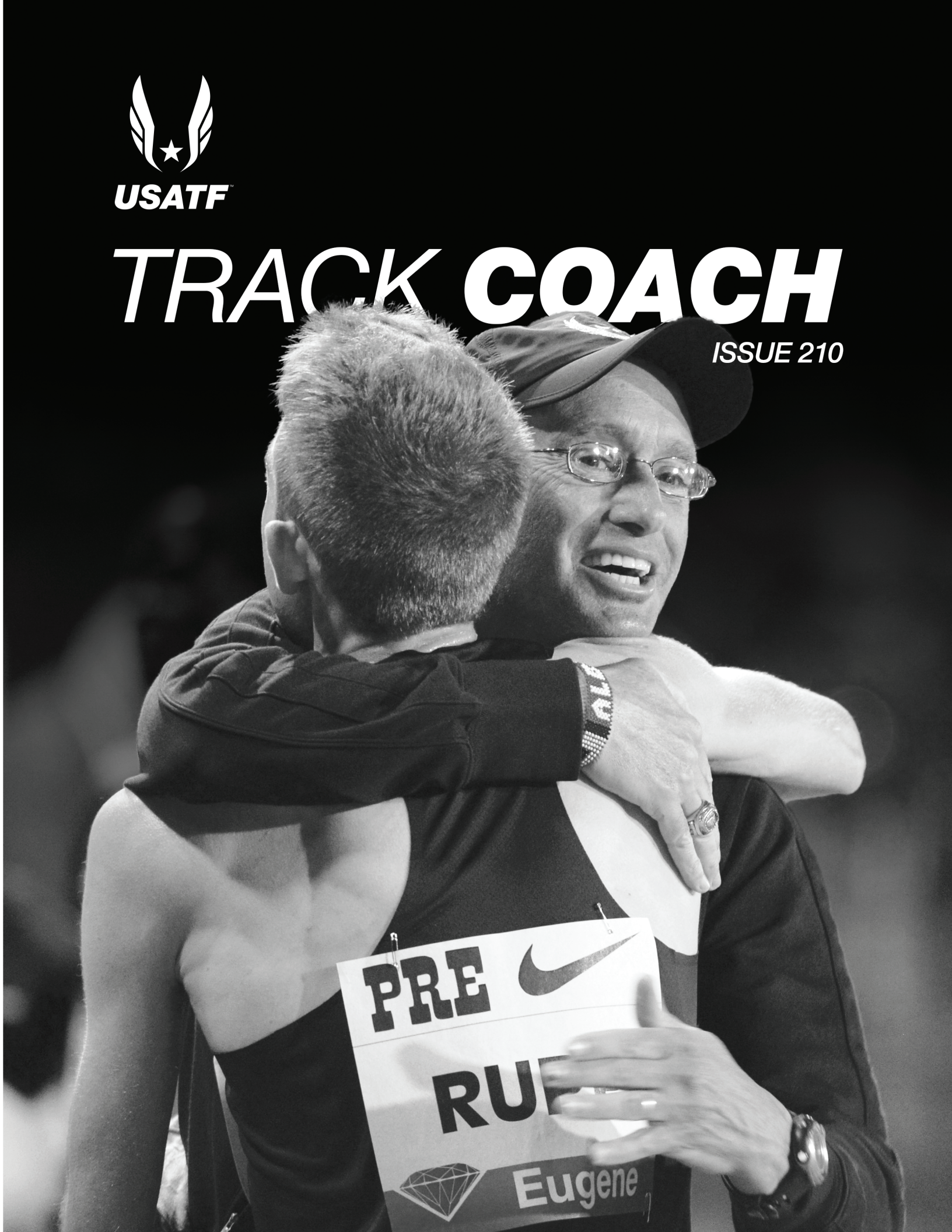
TRACK COACH

ISSUE 210



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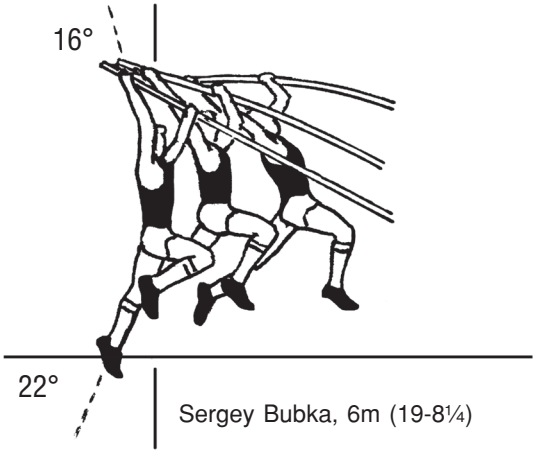
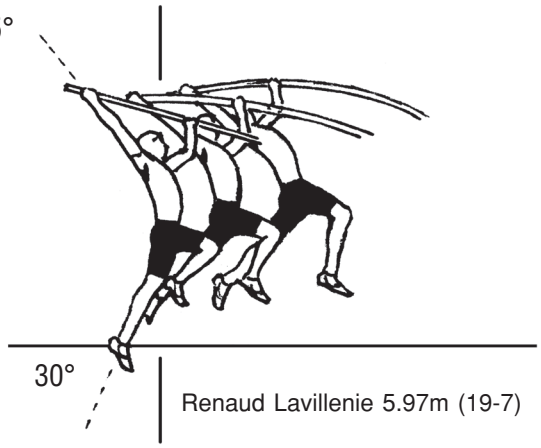


Sergey Bubka, 6m (19-8¼)



Renaud Lavillenie 5.97m (19-7)

The Importance of Takeoff Drive in Fiberglass Vaulting

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The official technical publication of USA Track & Field

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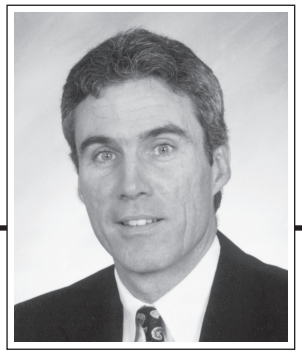
From the Editor

Russ Ebbets



STRESS, REST AND ADAPTATION

Barely a day passes when you don't hear somebody say, "I'm so stressed out!" Whether it is money or their marriage, training or their taxes, everybody dips into that well sometimes.

One of the ironic things about stress is that it is always referred to in a negative context. You could have just won the lottery or some recognition award and your first reaction is to publically announce the burden of your stress level. It might almost generate some sympathy for you, almost.

While I have no doubt our prehistoric ancestors experienced stress ("The mammoths are coming!") or Paul Revere ("The British are coming!"), even your father ("Your mother-in-law is coming?") all experienced their own stress level. But it wasn't until an Austrian born Canadian endocrinologist named Hans Selye applied the term "stress" to a challenging circumstance that this state of being came into being.

Even the use of the word stress is a story. Selye's command of English was so rudimentary that he confused the words stress and strain. Once he realized his mistake it was too late. The concept was in print, healthcare debates had started and the idea was slowly creeping into the general vernacular.

The other funny thing about this topic is that as a young research physician Selye was dissuaded by his mentor in pursuing research on the subject. Intuitively he knew he was on to something but when he sought validation from his mentor he was told that this line of thought would be tantamount to "wasting your life."

But Selye persevered and he didn't waste his life. And his work of the 1930's, 40's and 50's helped usher in the modern training era in track and field. Really?

In 1956 Selye published his landmark book, *The Stress of Life,* where he introduced the world to his General Adaptation Syndrome (GAS). The GAS was represented by a graphic curve that can be used to describe the life cycle from the dependency of infancy through childhood, adult self-sufficiency to old age

(Continued on page 6693)

On the cover: Pole Vault illustrations by David Bussagarger.

A Holistic View Of High School Track & Field Programs

Monty Steadman coached track & field in Northern California at the high school, community college and university level for almost 50 years. He recently completed his magnum opus, Coaches' Guide to Cross Country and Track and Field, *published in 2014 by Coaches Choice. This article is on a subject he deems critically important for any prep coach.*

*"**whole: n** 2, a complete organization of parts; unity; entirety, etc."*
Webster's New World Dictionary

THE SUM OF ITS PARTS

The concept of holistic track & field programs was developed by the late Ken Doherty in the original edition of his classic text, *Track And Field Omnibook,* Doherty, Kenneth, PhD, (Swarthmore PA: TAFMOP Publishers, 1971.) This concept explains the "wholeness" or unity of track & field teams and programs. As Doherty states on page 457, "Modern science is gradually accepting the idea that the ultimate organism is nothing less than the universe itself, taken as an indivisible whole." The "universe" of a track & field program is the "indivisible whole" of all the various parts functioning together for a common purpose.

In any given track & field competition, be it dual meet, small or large invitational meet, or championship meet, each school is represented by a *whole* team which participates in a given number of events that make up the *whole* meet. (A team can be made up of anywhere from one to fifty or more athletes depending on the circumstances.)

If team scores are kept for a particular meet, those scores represent the results of the total or the *whole* performance by all team members in all the events contested in the *whole* meet. *Every event contested in every meet is an important event. Every individual team member is an important part in the process of competing in every contested meet.*

The parts of the *whole* are the athletes and also the coaches. However, everything starts and ends with the athletes. A team exists for all of the athletes on the team, and the athletes exist for the *whole* team. Therefore the next step, after finding students to be team members and developing a coaching staff, is creating a program unified around the concept of the *whole* team.

PHILOSOPHY

The predominant three goals of the holistic program are *first,* to win or place high *as a whole team* in competitions and *second*, at the same time to develop each individual team member *as an athlete and as a person*. The *third* goal must be to also maintain and support the educational goals of the school or institution represented by the team

By Monty Steadman

and the educational goals of each athlete, as well.

The development of a team as a *whole* should be in the design of all track & field programs. This unity of purpose and function should be the constant focus of all teaching and coaching efforts. Coaches should work very hard to develop a sound and *whole* program, leaving as little as possible to chance.

The key to the design of a *whole* and complete program is *the utilization of all the parts of that program in a unified manner. A truly holistic program features a good coaching staff and the proper utilization of that staff for the development and proper event placement of each athlete within the program. Outstanding athletes who advance to major competitions are the by-products of successful programs.* The proper placement of athletes in events and event groups is key to developing a *whole* program and also to the personal and athletic development of those athletes.

With all coaches on a staff working together, sharing their expertise, duties, and responsibilities, and properly and creatively placing athletes in their best events, coaches can create a unified, *whole* track & field program. Coaches should do everything they can by creating a unity of purpose to make their programs as *holistic* and seamless as possible. *A good, unified, and comprehensive track & field program gives the student athletes in that program the best athletic and educational experience possible.* Coaches will not always succeed as well as they wish, but then athletics is always about attempting to do better, so coaches should keep on trying to improve and develop their programs. To paraphrase a famous saying, *coaching is a journey not a destination.*

The easiest way to demonstrate how this entire system can work in practicality is, while considering track & field coaches and athletes as parts of a complete *whole,* to examine the proper organization of a high school track & field program.

ORGANIZATIONAL GUIDELINES

The organization and management of all team activities, practices, and competitions throughout an entire season, should be grounded on the goals of a holistic track & field program. (See above.) There are four *holistic* concepts upon which successful, unified, and comprehensive track & field programs should be based.

- *All events and event groups on a track & field team are of equal importance. There should be no "second class" or neglected events.* There are some programs that emphasize some events and event groups over others. There have always been schools that are known as "sprint schools," or "distance schools," or "field event schools," or "jump schools," and so on. These situations are, in many cases, based on the major event interests of head or assistant coaches. In some programs athletes in some event groups received very little or no coaching or training, while on the same team other athletes in "favored" event groups are highly trained and very well prepared. Some programs will shunt most of the talented athletes into the "favored" groups.

  Coaches need to remember that if all events score the same number of points in meets, then all athletes in all events should receive the same high level of training, preparation, and coaching. In good programs coaches make every effort to properly train and maximally prepare every athlete in every event or event group. All event groups should work hard and receive good coaching. There should be no "easy" events.
- *The strengths and talents of all coaches and athletes should be utilized to the utmost. Athletes and coaches should be allowed to do what they do best.* To create a balanced and competitive track & field program athletes and coaches must be enabled to do what they do best.

  Sometimes head coaches assign assistant coaches who have expertise and experience in certain events to coach other events that are unfamiliar. (This is not to say that coaches cannot learn to coach new and unfamiliar events. However, while learning new events coaches should still apply their talents and expertise to familiar assignments.) Coaches should coach what they know best.

  Sometimes athletes who could do some things very well are placed in events for which they are not particularly suited. This can happen because coaches have some preconceived notions about these athletes' capabilities. Beginning athletes should be moved around until they are placed in events that seem to fit them. Sometimes this placement takes some trial and error, but eventually the proper fit can usually be made.
- *Every individual coach on a staff at some point in time should coach and contribute to the preparation of every athlete and event group in the program.* Because track & field is considered by many people to be an individual sport, a culture can sometimes evolve

that allows specific athletes and specific coaches to work together to the exclusion of other individuals in the same program. In the extreme, athletes might be heard saying, "You're not my coach; that coach is my coach." On some teams coaches might be heard saying, "You're not in my event; go see that other coach." This type of isolation and compartmentalization undermines the *holistic* team concept.

Each coach can and should provide any and all athletes with that particular coach's expertise. For example, programs should be organized so that the running workouts and sprint mechanics for all jumpers should be programed and supervised by the Sprint Coach. The Jump Coach should program and supervise all plyometric drills for athletes from other events, such as sprinters, hurdlers, and others who need that type of work. Most strength work and weight training should be programed and supervised by the Throws Coach. The Middle Distance And Distance Coach should program and supervise aerobic workouts for various event groups, and so on. In other words, everyone, coaches and athletes, in the program should be working with each other during certain portions of a given practice with everyone contributing what they do best.

- *The goal of a coaching staff should be to produce the most consistent, comprehensive, and competitive "overall" track program possible, every year.* To have a consistent *holistic* program year after year is not an easy thing to accomplish at some high schools. Every high school has a few of those magical seasons when the stars, athletes, and coaches all come together to produce spectacular teams or individual performers. These situations can be few and far between, especially in sports with as many variables as high school track & field. A transient student body, economic factors, and constantly varying talent and interest levels all work against consistency. The only variable a staff has any control over is that staff itself.

  Coaches should understand that if they can produce a consistently competitive track & field team every year, then those coaches can give all athletes on their teams, no matter the year or era, a positive, valuable athletic and educational experience. Regardless of the quantity or quality of athletes, coaches can and should always bring out the best in all of their athletes. If all athletes, no matter their talents and abilities, always do their best, teams will always be competitive. If coaches always do their best with every athlete every year then a program will be competitively consistent.

The following is a case study, which illustrates what can happen to an athlete when a program does not utilize all of its assets in a unified, holistic manner:

Case Study " They already had some guys."

A young man came out for our track & field team who was blessed with a great deal of speed and talent. His sophomore year he earned a key spot on our team. For dual meets, he competed at the Varsity level. This young man ran on both the 4x100 and 4x400 relay teams, the 400, and his best event, the 300 hurdles.

During that period of time there was an invitational meet toward the end of the season that brought the top eight athletes from each event in our section together for an evening meet. This meet had grown into a very "big deal" track & field meet. One level of competition in this meet was Frosh/Soph Boys, and varsity freshman and sophomore athletes were allowed to compete as Frosh/Soph in this meet.

Being a sophomore, the young man under discussion competed in both relays and the 300 hurdles in this meet. He won the hurdles in school record time. He ran a brilliant anchor leg on the 4x400 relay and led the team to victory. His efforts, along with those of his teammates, earned them the Frosh/Soph Team Championship in the meet that year. He also was named "Frosh/Soph Athlete of the Meet." When the meet was over, he had become one of the hottest young prospects in our section that year in the 300 hurdles.

After the season was over, the young man came to us coaches and informed us that his family was moving over the summer. Next fall he would be attending another high school in our section that was known for its outstanding track teams. We wished him, "Good luck." We were sorry to see him go.

The following spring we saw the young man at several invitational meets where our team and his school's team were competing. He was mostly doing relay work and running the 200.

"Why aren't you running the 300 Hurdles?" "Oh, when I got there, they already had some guys who were running that event, so they put me in the 200. Right now, I'm not even conditioned to run the 300 Hurdles anymore." A little bit shocked, I asked him, "Did they try you out or run you with those guys who were already running the 300's?" "No! Because they already had some guys, they said that I should run the 200."

To my knowledge, he never ran the 300 hurdles again. As a result he was

never able to reach his full potential as a track athlete in his best event.

TAKE AWAY POINTS

Coaches should be very carefull to place individual athletes in situations which help those athletes contribute to the *whole team* while also helping those athletes to grow and develop in their best events. When coaches have preconceived notions about a "new" athlete's potential or abilities, coaches may miss a chance to develop a good athlete into a better one who could help to improve an entire team.

No athletes in a given event should have "reserved" slots in that event. If someone good comes along, that athlete should have a chance to compete for a slot in the event.

To review, these holistic concepts consider a track & field team as a "whole entity" made up of separate but interconnecting and interdependent parts. Each individual athlete, each event group, and each coach, are parts of the whole team. For the team to be successful this interconnectedness and interdependence must be developed and nurtured at every practice and in every competition.

With these four holistic concepts in mind, all practices should be designed around the following five basic guidelines:

- *Practice should always start with the entire team warming up together.* There can be no exceptions to this. Only after a team warm-up has been completed, can the various event groups then perform additional event or group-specific warm-up drills. All team meetings and team announcements should occur at the conclusion of the team warm-up.
- *Every team member, no matter the event or event group, should perform some sort of running workout every day at practice.* Even the throwers should run. These running workouts by design must be tailored to each event group's unique fitness requirements, but everyone should always run. The Sprint Coach should supervise all team members other than throwers and middle distance and distance runners during running workouts.
- *Every team member, with the exception of most of the throwers, should be considered a potential 400-meter runner; therefore, all sprint training should revolve around 400-meter training.* All runners, (middle distance, distance, sprinters, and hurdlers), and all jumpers should do some 400-meter training. Sprinters and hurdlers can benefit from the strength that 400-meter training provides. This training can benefit jumpers as well, especially those competing in multiple jumps and/or other running events. Middle distance runners can be helped by the speed provided from 400-meter sprint training.

  Also, every member of a team, with the exception of most of the throwers, at some point during the season should be asked to run a leg of a 4x400 relay. (Occasionally a thrower might also run a leg on the 4x400 relay.) Since this will be expected of all runners and jumpers, all of these athletes need to be prepared to run a 400 in a relay. There is no more painful experience for a young track or field athlete than having to run a 400 and not being prepared to do so. As a result of some 400-meter sprint training, all athletes can be prepared to race a 4x400 relay leg whenever they are asked to.
- *Every team member should be required to do some weight training.* Throwers normally should be in the weight room three or more times a week. Everyone else on a team should be in the weight room at least twice a week. Not only do these weight training sessions improve general and specific event fitness, it is believed that these workouts can help reduce the incidence of injuries that can occur due to heavy training and competing.

  *The training emphasis for the pre-season, as well as for two thirds of the regular season, should be based on quantity and strength rather than quality***.** Although some speed training should be included in every workout, *quality speed* should become the major training emphasis only in the latter stages of the competitive season. Strength is the foundation upon which speed and technique can be applied for all team members.

With the five guidelines as anchor points, coaches can begin to build and develop holistic, comprehensive, and successful high school track & field programs. A holistic program can provide proper coaching and training for all athletes in all event groups in a program. The gifted and the not so gifted athletes can all develop, improve, and meet or even surpass the athletic potential in a comprehensive, holistic track & field program. Programs designed in this way can provide all their athletes with a positive and rewarding track & field experience.

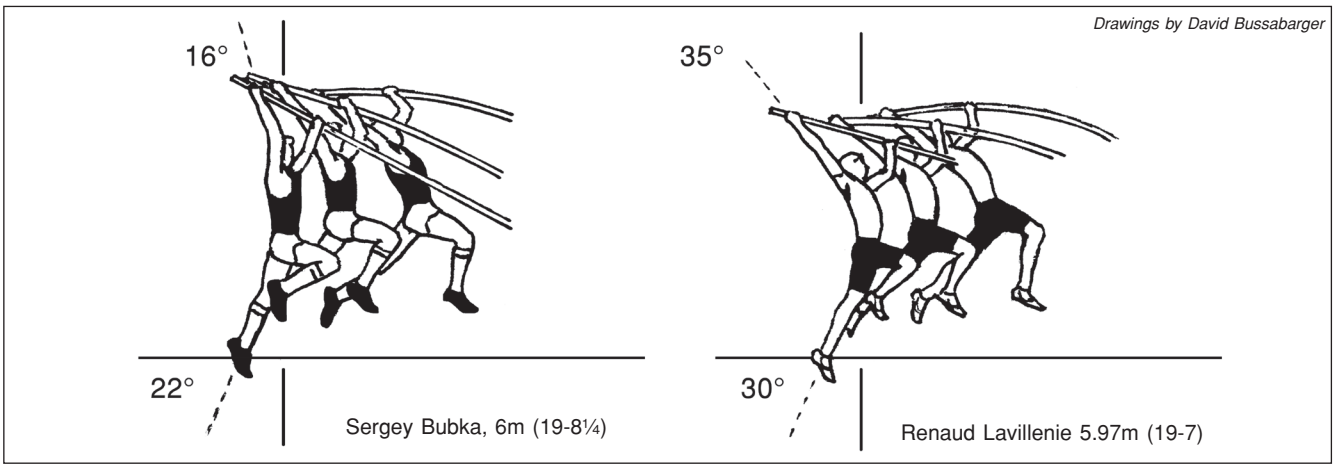
Monty Steadman can be reached at steadman-dm@sbcglobal.net

The Importance of Takeoff Drive in Fiberglass Vaulting

It is Bussabarger's view that the mechanics of a correct fiberglass takeoff are very different from that of a good rigid-pole vaulter. The free takeoff concept, as developed by Petrov, however, claims that fiberglass vaulters should take off essentially the same as rigid vaulters. Bussabarger contends that fiberglass vaulters must accentuate forward takeoff drive into the pole, which causes the pole to bend inward and compresses the pole axis at takeoff. Rigid vaulters, on the other hand, tried to minimize the contact force of the takeoff and emphasized rotating the pole upward toward vertical—not good technique for fiberglass vaulting.

In Alan Launder's book *From Beginners To Bubka*, he quotes outdoor world record holder Sergey Bubka as saying "The pole should bend as a result of the speed and mass of the vaulter after the vaulter leaves the ground, therefore it is more important to concentrate on moving (rotating) the pole towards the plane of the bar, rather than being aware of bending it."

This statement concisely sums up the underlying concept behind the free takeoff (which is derived from past rigid pole vaulting). That is, the vaulter should primarily emphasize developing rotational movement in the pole's axis during



By David Bussabarger

the takeoff and not bending the pole until the vaulter is off the ground.

To achieve this the takeoff point should ideally be "out" (the toe of the takeoff foot should be behind the vertical plane of the top hand at the moment of takeoff). The vaulter should emphasize springing upward off the ground and finally the arms should be fully extended and push upward as the vaulter takes off.

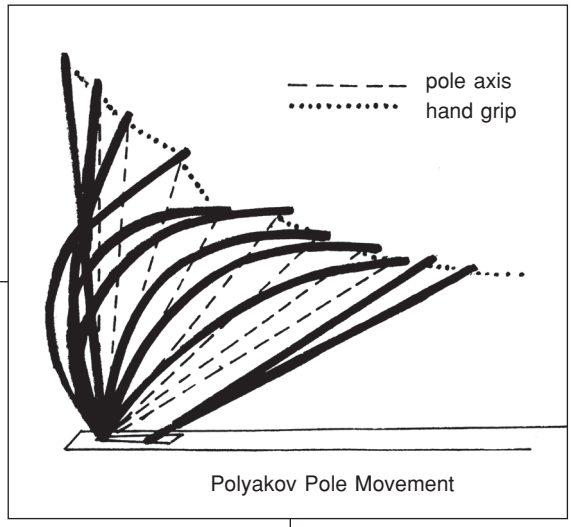
Examination of Bubka's positioning at the moment he leaves the ground on his first 6m vault exemplifies the execution of a free takeoff action. At this point in the takeoff his overall body positioning only slightly deviates from straight up and down. Bubka's top arm is bent back only 16° from vertical and his takeoff leg is bent back only 22° from vertical. Once airborne Bubka's CG quickly gains upward height from the ground which produces a relatively high takeoff angle. Despite this fact, Bubka is still able to achieve good forward drive during the execution of the takeoff. Note the forward movement of his torso through the takeoff.

Although Bubka achieves outstanding success using a free takeoff, it is the writer's point of view that the free takeoff concept is itself flawed, the source of the problem being that it incorrectly strives to directly transfer rigid vaulting takeoff technique to fiberglass vaulting.

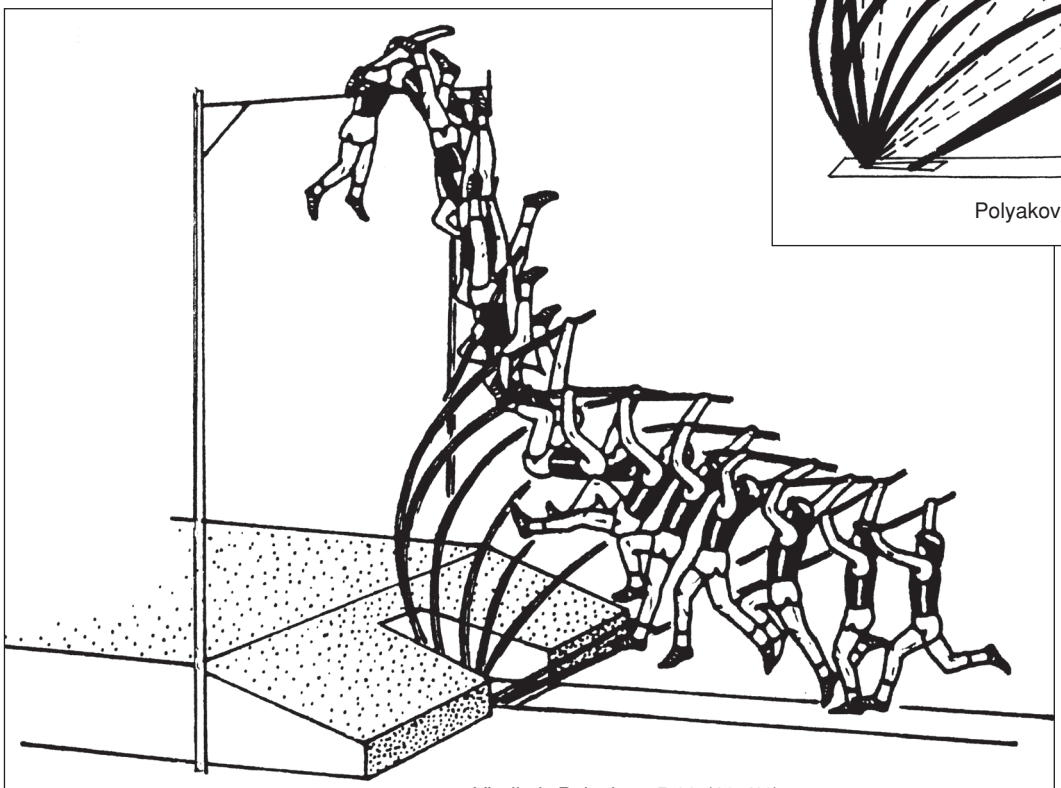
In correct fiberglass vaulting the pole is both bent and rotated towards vertical and not simply rotated towards vertical like a rigid pole. As the result of the correct development of forward takeoff drive, in a well executed fiberglass vault, the vaulter's top hand on the pole moves in a dominantly forward direction from the takeoff until the final stages of the rock-back, where it starts to gain significant vertical height.

At the same time coinciding rotation in the pole's axis (the invisible cord from the top hand to the tip of the pole in the box) naturally results from the vaulter's spring-

Drawings by David Bussabarger



Polyakov Pole Movement



Vladimir Polyakov, 5.60 (18-4½)

These illustrations demonstrate the idea that the pole is simultaneouly bent and rotated to vertical, not simply rotated to vertical. Polyakov had very good forward takeoff drive, illustrated clearly here.

off action at takeoff. This means that proficient fiberglass vaulters confront much less gravitational resistance when moving the top hand on the pole towards vertical vs. rigid vaulters.

This a key reason why fiberglass vaulters can grip so much higher on the pole. To quote biomechanics expert Dr. James Hay, "If the vaulter drives forward into the pole, the magnitude of the parallel forces and the resulting bending of the pole are correspondingly greater."

In contrast to Sergey Bubka, new world record holder Renaud Lavillenie displays truly outstanding development of forward takeoff drive. Lavillenie typically takes off directly under his top hand. However, on the the takeoff of the 19'7" vault shown, he takes off "under" (the toe of the takeoff foot is ahead of the vertical plane of the top hand at the moment of takeoff). Lavillenie employs a forward/upward spring-off action vs. Bubka's more upward spring-off action. This in turn results in a lower takeoff angle.

Note that Lavillenie's top arm is bent back 35° and his takeoff leg is bent back 30° as he leaves the ground. In effect his body is much more forwardly shifted than Bubka's at this point which creates superior forward takeoff drive.

This produces two advantages. First, the much slower (11.03 100m vs. 10.3 100m) and shorter Lavillenie (5'9" vs. 6') is able to grip as high as Bubka (roughly 17'). Secondly, Lavllenie achieves greater compression of the pole axis as he bends the pole. The fact that he achieves greater and deeper bending of the pole vs. Bubka is a good indicator of this fact.

To quote renowned coach Ken Doherty "The forward driving action at takeoff must be accentuated in order to get optimum bend and therefore propulsive force out of the pole." More specifically, the compression of the pole's axis increases propulsive force as the axis of the pole expands during the pole's recoiling action. This gives Lavillenie a superior catapultic action during the vault vs. Bubka. Note that Bubka compensates for this by developing a very powerful active swing/rock-back and vertical extension which help propel him up and over the bar.

Finally since the free takeoff concept denies the importance of the development of forward takeoff drive, teaching it to novices means they often never learn to execute the takeoff properly,, which greatly retards their vaulting potential.

FROM THE EDITOR

Continued from previsous page 6686

and a return to dependency until you fall over and it is on to the next life.

Conditions, diseases, illnesses all, more or less, follow the GAS curve. The Russian sport scientists thought this was a pretty good idea. They played around with a few variables, massaged the shape of the curve a little settling on a sine wave pattern that was comprised of three stages—stress, rest and adaptation. One of the scientists of the group was Yakolev and the curve the Russians developed came to bear his name—Yakolev's model. This managed stress curve could be applied to the development of biomotor skills and such training qualities as time of effort, the recovery interval, the intensity of the effort and the nature of the effort whether it was running, lifting, swimming or something else.

In this way the managed stress was actually a good thing if it was progressively applied with a specific intent. When this "good" stress was applied judiciously the adaptation by the athlete's body over time increased work capacity. For coaches the application of managed stress led to a greater training effectiveness from one workout to the next and over a week, month, season or career.

When the stress load is meted out in this manner the body adapts to the stresses placed upon it. This enhanced adaptation results from the application of progressive overloads, specificity of training and anatomical adaptation, concepts that have become part and parcel of modern training theory.

All the great coaches and training theorists that have followed are indebted to Selye for either trusting his gut or not being smart enough to know when to quit. Maybe it was a little of both, but regardless, what we do today is the result of the riddle he grappled with almost 60 years ago.

The Effects Of Different Field Environments On Cognitive Strategies, Performance and Rating Of Perceived Exertion

Research findings regarding Rating of Perceived Exertion (RPE) lead the author to posit some practical value for the coach from these studies.

There is general agreement in the exercise science community that Rating of Perceived Exertion (RPE) has practical use in the prescription of exercise. It is clear that athletes can duplicate exercise intensities accurately by using RPE. The ability to learn self-monitoring of exercise intensity is a useful trait that will enable an athlete to train or race at prescribed intensities intuitively without the use of expensive equipment. Additionally, there is further evidence that the *field environment* in which an athlete conducts a workout has a subconscious impact on the cognitive strategy the athlete might choose to employ while exercising. Further, evidence strongly suggests the cognitive strategy chosen will have a significant impact upon RPE—or more precisely, on the perception of physical effort. The central purpose of this paper is to explore the idea that a distance runner's cognitive strategy for a running workout might be manipulated by changing the field surface and field environment. Specifically, if a distance runner is able to run faster on one particular field surface or environment than another while reporting identical RPE, then this trait might be exploited by a coach or trainer.

REVIEW OF LITERATURE

There is strong evidence in the literature that *field environment* can play an important part in the type of cognitive strategies endurance athletes use while exercising. Additionally, there is evidence that the type of cognitive strategy used by an endurance athlete during training may contribute to faster or higher quality training bouts under certain conditions. It is the author's opinion, based upon a review of literature regarding the subject of RPE and

By Ryan E. Bailey

many years of observation, that a distance runner will often adjust his/her exercise intensity, if not his/her RPE, based upon the cognitive strategy employed during a bout of exercise. The cognitive strategy may necessarily change, to an extent, based upon the field environment in which the workout is executed.

A casual observation of trained distance runners seems to indicate that the athletes tend to seek out *attentional distractions* (e.g. a change to a novel venue or listening to music through headphones) and prefer an *external cognitive strategy* during workouts they find unpleasant or particularly difficult. Other observations by the author suggest that those runners who habitually utilize these same *external cognitive strategies* during races have significant difficulty in accurately pacing themselves and often produce poor results that are inconsistent with their training.

Those athletes who have the ability and willingness to use internal cognitive strategies are clearly more able to consistently achieve pre-set time goals in races. If these assertions are true, then the use of RPE and manipulation of field environments to help control training and racing paces may have real, pragmatic applications for coaches.

The descriptive phrase "*Rating of Perceived Exertion*" (RPE) is best explained as a self-selected, subjective measurement of an exerciser's overall level of exercise intensity. The Borg Scale is the most common instrument for measuring RPE. Gunnar Borg devised his scale in the 1970s. In its original form, the scale ranged numerically from 6 to 20 (Borg 1970). Later, Borg developed his "Category Ratio" (CR) scale, described as a scale of 0 to 10, with zero being no exertion and ten being maximal exertion. The Borg CR10 scale may now be more widely used for exercise and sport science applications than the Borg RPE scale. Both scales are reviewed in detail by Gunnar Borg himself in his 1990 paper "Psychophysical scaling with applications in physical work and the perception of exertion" (Borg, 1990)

Ekblom, Day, Hartley, Moore and Wear (1974) were able to show that trained, as well as untrained subjects were able to reproduce various rates of exertion during bicycle ergometer tests based on the researcher's verbal instructions. Later, Ceci and Hassemen (1991) conducted a study employing two different field environments (treadmill and outdoor track) that was aimed toward investigating the use of RPE as a means of regulating the intensity of acute bouts of exercise. They compared how accurately exercise intensities could be controlled while performing work on a treadmill and work done in a field situation over a period of four weeks. Ceci and Hassemen concluded that the subjects could accurately reproduce exercise intensities on both a treadmill and a track, guided by the researcher's verbal/numerical instructions—i.e. RPE guidelines (Ceci & Hassmen, 1991).

Takai (1998) showed that runners who used internal cognitive strategies were able to set and then achieve target race times with a fair amount of accuracy. He also showed that *runners using external cognitive strategies were much less able to set and maintain an appropriate pace during a race. However, where training is concerned, Pennebaker & Lightner (1980) showed that an internal focus during a bout of exercise can increase the subject's RPE. In another study it was shown that "external focus strategy produced greater actual performance and greater subjective effort"* (Padgett & Hill, 1989).

So what are the practical implications for a coach or trainer? It seems that it is important for a distance runner to learn how to use internal cognitive strategies for pace-setting in workouts and appropriate pacing during a race. However, during some training bouts, it may be beneficial to the athlete to resort to external cognitive strategies in order to improve the quality of exercise.

The term *field environment* in the context of this paper refers to the varied surroundings an athlete is faced with during each bout of exercise. An indoor track (field environment) has a similar field *surface* to an outdoor track, but also has significant field environment differences to consider—not least of which is the shorter length of the track and the severity of the curves necessitated by its shorter circumference. The fact that the track is indoors also limits the amount of stimulus available to engage the athlete's senses when compared to an outdoor track is also a primary difference in field environment.

Likewise, running on an outdoor track is significantly different from running in field environments such as grass or dirt trails in a park setting. For instance the flat, uniform surface of the outdoor track allows the runner to negotiate the track with minimal attention to where his feet are placed. Conversely, a grass or dirt path requires a greater level of concentration and attention to safely negotiate. In addition, a path within a park or forest setting provides the greatest variety of stimuli to draw the attention of the runner.

Evidence suggests that the greater the available stimuli, the more likely the athlete will em-

ploy an *external cognitive strategy* and report a lower RPE relative to the actual physical intensity of the workout. Therefore it is the stance of this author that, by manipulating field environments, a runner can be induced to train at a higher rate of speed (pace) without eliciting a higher RPE.

The three field environments and surfaces presented above differ mainly in the amount and variation of stimuli present. The amount of concentration required by the runner to safely negotiate the route and the number of other things available for the runner to attend to visually and kinesthetically also varies by degrees between these field environments (Pennebaker & Lightner, 1980). It is the author's hypothesis that a change of venue to a field environment rich in sensory diversions can redirect cognitive strategy from internal to external. Further, a change from internal to external cognitive strategies should allow a runner to exercise with increased vigor, while masking the increase in intensity due to attentional distractions.

An athlete's RPE deals with the individual's perception of a number of different physiological signals to physical stress and the way each individual interprets those signals. Perceptual cues ranging from very general feelings of exertion and more specific cues such as muscular pain or rate of respiration contribute to the athlete's perception of effort (Borg & Noble, 1974).

Measurement of RPE is achieved after an acute bout of exercise by using the Borg Rating of Perceived Exertion, or Borg scale (Borg, 1970). While the use of RPE is appropriate in any environment, e.g. a treadmill (clinical environment) or any number of non-clinical field environments, certain factors can affect its accuracy or efficacy in exercise prescription. Indeed, RPE is considered subjective in the sense that it varies due to individual differences and the fact that RPE itself is subject to the psychological and affective facets of the individual (Pennebaker & Lightner, 1980). It is this very psychological/affective subjectivity that should, under certain circumstances, allow RPE—or more precisely, a subject's pace at a certain RPE—to be manipulated by a coach by thoughtful changes of venue throughout a training regime.

A discussion of the impact of different field environments upon a person's RPE may be germane to the discipline of coaching. It is important to understand that RPE is, in large part, a construct of each individual athlete (e.g., Rejeski & Ribisl, 1980) and therefore should be subject to manipulation. A study headed by Rick LaCaille also found that the field environment in which a group of athletes ran had a significant impact upon RPE. In this study, the researchers compared three "exercise settings" (i.e., a treadmill, an indoor track and outdoor field environments). Running on a treadmill produced the highest RPE while running on an outdoor route produced the lowest RPE despite identical workout intensities controlled by the use of heart monitors (LaCaille, Masters & Heath, 2004). In fact, physiologists have consistently found that what a person perceives themselves doing is equal in importance for achieving appropriate exercise levels as the true metabolic cost of the activity (Rejeski, 1985).

DISCUSSION

I (the present author) have had the opportunity to observe both trained and untrained runners for over 30 years and have coached both high school-age and collegiate-aged runners for the last fifteen years. During this time, a discernable and consistent pattern has emerged that suggests athletes will often experience a change in perceived effort relative to the field environment in which they exercise. Over the years, my athletes have regularly expressed a strong preference for running in those field environments that offer more varied terrain / environmental stimuli.

For example; given a choice of three different park settings, my athletes generally express a preference for the largest park which has the greatest number of trail choices. The athletes express this preference despite the fact that the park in question is significantly farther away and less conveniently located than the other two choices. Further, there is a plainly obvious and marked preference among my athletes for training in any of the park settings over training on the much more convenient one-mile dirt track that is available near campus.

The track in question is a former horse racing track and is ideal for long interval or repeat style workouts. The dirt track's surface is flat, relatively free of any obstruction, clearly marked in 200 meter segments and bisected by a path into 800 meter halves. In other words, it is an ideal situation for training—from a coach's perspective.

However the athletes, by and large, dislike training in this setting. They generally prefer to do interval or repeat workouts in the park—despite the fact that they must negotiate hills and sharp turns in that setting. Moreover, the athletes appear to report higher RPE scores when training on the horse track as compared to similar, or

even identical workouts and times in different venues. When I ask the athletes why they dislike the horse track, the most common reply is that the track is "boring". Despite the aversion my athletes seem to have to the horse track, it is still a useful tool from a coaching standpoint so I still schedule workouts there. The horse track is flat, accurately measured and allows the runners to check their times easily and often. Because of those qualities, I sometimes schedule sustained distance workouts with specifically prescribed paces there. The athletes will often request that I allow music headphones during these workouts.

I don't normally allow headphones during practice. My athletes generally need to be able to hear and communicate with me during workouts and headphones can represent a safety hazard in some training settings. However, during the horse track workouts described above I have relented on this rule. I permit the headphones in this circumstance for two main reasons: 1. The track is a safe venue and 2. The headphones add *attentional distractions*, encourage a shift toward a more *external cognitive strategy* during the workout and *minimize the disagreeable aspects of the horse track field environment*.

Casual observation has shown me that the athletes seem better able to complete the workout with the music and I suspect their reported RPE may actually be slightly lower as well. By allowing the headphones I can exploit the conveniences of the horse track while neutralizing its negative psychophysiological effect on the athletes.

I have come to believe it is beneficial for a coach to have an understanding of cognitive strategies in an exercise setting. It is clear that elite endurance athletes will gain a mastery of internal cognitive strategies in order to control pace – especially during a race. An effective coach must teach and encourage the use of internal cognitive strategy as this is a vital skill any runner must have in order to consistently improve in competition. However, as a runner matures, it is common for him or her to largely abandon using the external cognitive strategy. It is my stance that under certain, narrow applications, it is beneficial for the coach to encourage an athlete to shift back toward the external cognitive strategy.

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Using Heart Rate To Gauge Exercise Intensity

Learning how one's percepton of workout intensity relates to the actual measure of intensity is important in the training of athletes. This small study tends to support the idea that, with conditioning, athletes may be better able to sense their true exertion and hence train at more appropriate levels.

ABSTRACT

Ten high school male multi-sport endurance athletes (aged 13 to 17 year old) were tested using a progressively resistant treadmill test. Heart rate and perceived exertion were measured to determine both the athletes' actual exertion and their perception of how hard they were working. Following testing, these athletes participated in an 8-week conditioning program consisting of aerobic exercise (running), core strength training, agility training, and flexibility training. Athletes were encouraged to wear heart rate monitors to develop an understanding of their exertion and how their perception and actual exercise intensity were related. At the end of the conditioning period athletes repeated the treadmill test to measure changes in fitness. Results indicated that fitness did improve after conditioning. Heart rates at specific treadmill speeds were lower and athletes were able to endure increased treadmill speeds.

INTRODUCTION

Participant understanding of exercise intensity in sports is a key to improving fitness. Many athletes will perceive they are "working hard" when, in fact, they are not. Others will push themselves too hard and either tire too soon to realize fitness benefits or they will suffer the consequences of overtraining. Use of a heart rate monitor can allow athletes (and their coaches) to see a measure of their exercise intensity. They can then adjust their efforts based on physiology rather than feelings. The purpose of this study was to test a group of athletes using heart rate monitors and perceived exertion measures. Athletes would then participate in a conditioning program using the heart rate monitors. A final test would indicate changes in fitness. Secondly, athletes can learn how their perceptions of exercise intensity and their measured activity levels relate. Thus, they would be better able to improve their fitness through appropriate levels of exertion.

RESEARCH BASIS

The use of heart rate monitors during exercise has been validated by numerous studies (Nelson, Pels, Geenen, & White, 1988; Polar Electro, 2012). To summarize these studies, many of today's commercially available monitors can be used during exercise to reliably and validly measure heart rate. They are generally as accurate as EKG machines. Further, most devices allow for downloading of data into computers for further data analysis and software is available to use those heart rates in developing training regimes for both elite and

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recreational athletes.

The most accurate heart rate monitors use a strap-based monitor that is placed around the chest. Electrical signals originating in the heart are detected by electrodes in the strap and wirelessly transmitted to a watch-based receiver. The receiver can not only store heart rate information but also time information and newer models have GPS features that can be used to analyze heart rates based on terrain and distance information. This study used a model FT-40 Polar Heart Rate Monitor during testing and training.

In an original work (Crowhurst, Morrow, Pivarnik, & Bricker, 1993), heart rate monitors were used with nine female high school students participating in physical education classes. The process began with laboratory measurement of heart rate and oxygen consumption (VO_2) during a progressively resistant test on a bicycle ergometer. As the students worked harder, heart rate and oxygen consumption were recorded using a computer-based system. Following data collection, statistical analysis software was used to develop an individual regression equation for each student. This equation allowed entry of heart rates that were measured during physical activity and generated reliable estimates of oxygen consumption and caloric expenditure during exercise.

The results were that some modes of exercise were good for developing fitness while others were not. It was also noted that the motivation of participants was also an indicator of whether or not students would get enough exercise. The study pointed to the need for further research.

Among the issues identified included the notion that numerous variables could affect heart rate during exercise. The current health, hydration, body temperature, state of mind, age, and fitness of the athlete can affect the heart rate response to various forms of exercise.

Further, the use of heart rates in monitoring exercise is individualistic—that is, comparison of athlete heart rates during exercise is impractical.

There were other issues that the original research raised. One was the notion of maximum heart rate. A popular formula for estimating maximum heart rate was 220-Age. However there is little or no research to validate that formula (Robergs & Landwehr, 2002). A simple test is needed to determine how an individual responds to exercise. This is especially true for athletes who do not have access to laboratory equipment.

TESTING PROCEDURES

With elite athlete training facilities and an adequate staff of exercise physiologists, laboratory testing can help us understand appropriate heart rates for training. For athletes and coaches who do not have advanced laboratories for testing, a simpler test can be employed.

The chart in Figure 1 illustrates a test conducted at a local fitness club using a heart rate monitor and a treadmill. The test began with measurement of seated heart rate. The subject was seated next to the treadmill for several minutes until the heart rate stabilized at a relatively low level. Next the subject stood on the treadmill for two minutes. Then the treadmill was started at one mile per hour (mph) and in two-minute stages, the speed was increased to 2 mph, 3 mph, 3.5 mph, 4 mph, 4.5 mph, etc. until the subject felt they were working "uncomfortably hard."

The notion of "uncomfortably hard" is important. Even if laboratory equipment is available for measurement of peak VO_2 and anaerobic threshold, most training is conducted at a lower intensity. Thus, when the athlete reaches a point where continued exercise is

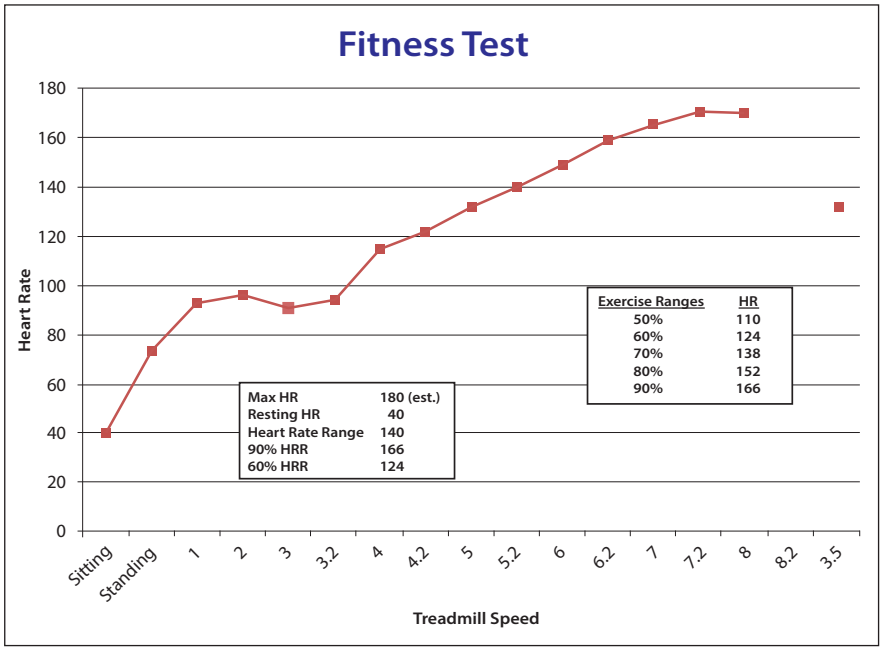

Figure 1: Results of a simple heart rate test.

becoming uncomfortable, we have an estimate of the heart rate they should use for training of anaerobic energy systems. At the point where they feel they can no longer continue, we can estimate they have reached their maximum heart rate.

Following initial testing athletes participated in a pre-season conditioning program. Athletes participated in two workouts per day with the morning workout consisting of running and flexibility exercise and the evening workout consisting of core strength training and agility types of training. Athletes were instructed to wear their heart rate monitors and were instructed to keep their heart rates within their individual training zone (60% to 85% of heart rate reserve). If their heart rates were getting too high they were to slow down and if their heart rates were too low they were to increase their efforts.

Athletes were reminded to also think of their *perception* of effort. Were they exercising too hard while perceiving they could work harder? Or, did they perceive their exercise was too hard while their heart rate indicated they could much more?

Following the training period (eight weeks), athletes repeated the treadmill test. Athletes began by standing on the treadmill for two minutes and the treadmill was then run at the same speeds as the previous test. Heart rates for athletes were also measured at the end of each two-minute period. Athletes were asked to continue the test until they felt they could not continue.

RESULTS

During the first treadmill test, athletes were found to have a seated heart rate of 81 beats per minute. During the second test seated heart rates averaged 80 beats per minute. Average heart rates at various speeds are displayed in Table 1 (below). Athletes averaged a max treadmill speed of 7.5 miles per hour during the first test and 8.5 during the second test. On average the athletes averaged 7.5 beats per minute slower heart rates over the various speeds. Figure 2 (below) shows average heart rates across all subjects for the various tests. It also appears that in the speed range where most of the athletes were training, there was a greater difference between Test 1 and Test 2 heart rates.

	Test 1	Test 2
Sitting	81	80
Standing	98	87
1	99	94
2	104	98
3	115	106
3.5	120	118
4	131	124
4.5	147	136
5	163	151
5.5	169	154
6	174	162
6.5	171	166
7	183	172
7.5	186	175
8	183	180
8.5	183	181
9	186	185
9.5		186
10		190

Table 1: Average Heart Rates for each treadmill speed.

DISCUSSION

Based on the test results, it appears the athletes did improve their fitness. Athletes had lower heart rates at various speeds and also ran longer (and at higher speeds) during the second test. Athlete perceptions of their efforts were also lower during the second test. To some extent, we can suggest that athletes came to understand what their true exertion was and how that related to their perceptions. Over the eight-week exercise period athletes not only improved their fitness but they

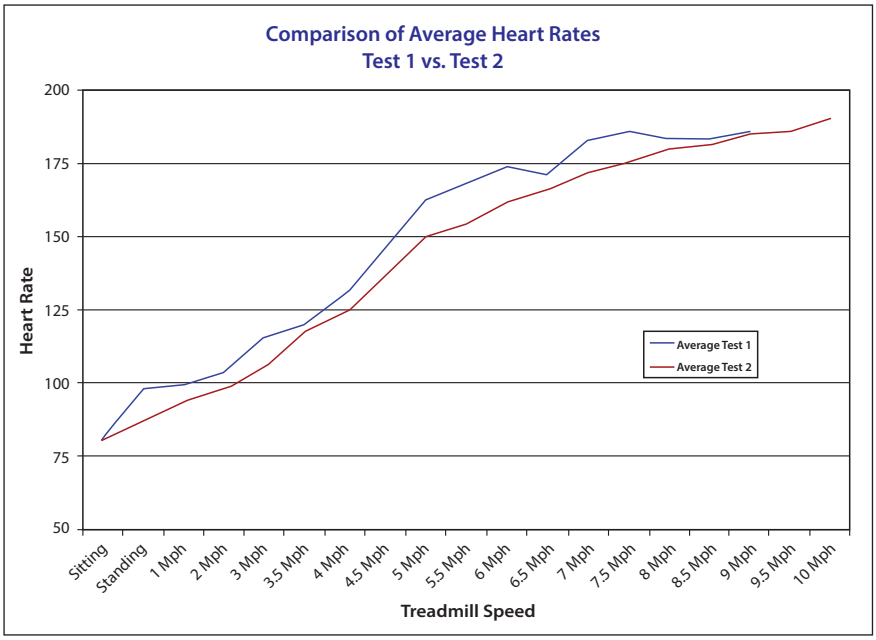

Figure 2: Average test results for two treadmill tests.

gained a level of confidence. They understood they could do more and they ran faster on the second test. The use of a simple treadmill test can give athletes (and coaches) an objective measure of their true exertion during exercise. Training at appropriate intensities appears to generate higher levels of fitness. At the same time, when athletes can see they are working at the appropriate (heart rate) level they learn and adjust their perceptions.

Coaches can also use the heart rate information to calculate effective ranges for other training activity. Repeating these tests help us to validate training protocols. If the test is repeated and higher levels of exercise are required to reach various heart rate levels (50%, 60%, etc.) we can assume that our training is improving in those ranges. As an athlete gets fitter, we would expect the heart rate trend line to go lower on the heart rate (Y) axis.

CONCLUSION

There are numerous "extraneous variables" that affect heart rate and they need to be considered in the overall training regime. External temperature can have a major effect on an athlete's performance. Whether it is hot or cold, heart rates should be affected and training modified.

Hydration levels will also affect heart rates as will emotional stress and fatigue. All of these should be factored into the athlete's workload.

Another consideration is that heart rate response to exercise is individual. Though we presented group information for summary purposes in this study, we could not use this summary information to develop training for the whole group. Coaches need to look at individual athletes and their results to develop specific training protocols for each athlete.

Heart rate can give coaches and athletes an objective measure of exercise exertion. In combination with perceived exertion coaches and athletes can train optimally and safely to achieve improved performance.

SAFETY ISSUES AND HEART RATE MONITORS

Using a heart rate monitor by itself does not mean that an athlete is working at a safe or effective intensity. Several other considerations must be kept in mind by athletes and coaches alike. The "Perceived Exertion" scale (Borg, 1998) we used allows an athlete to rate their exertion on a scale of 1 to 10. Daniels (2004) wrote of the notion of "comfortably hard" training in which an athlete gauges his/her exercise intensity based on subjective feelings. Though both of these methods are subjective, they exhibit some merit. If an athlete is ill, dehydrated, overheated, or excessively fatigued, he will not perform well—in practice or in competition. Thus, in combination with a heart rate monitor, an athlete's perception of his effort should give their coach a comprehensive view of an exercise load.

If a coach simply looks at heart rate, it is little different from simply looking at times on a stop watch. To some extent, the coach must remember why we are here. There must also be a balance between training and healthy living. A college or elite coach might need to be reminded of that as much or more than a high school, club coach, or parent. Most athletes (from elites to recreational) want to improve. Safe training that is set at appropriate levels of stress is essential. Heart rate combined with perceived exertion and conscientious coaching can be used in combination to train athletes optimally.

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Training Maxims

Words to live by. Track Coach *editor Russ Ebbets gives you 25 "points of light" that could be sensible foundation stones for your coaching philosophy.*

A maxim is a pithy statement that the dictionary defines as a "concise rule of conduct." And while that may allow the maximist to get a little preachy the lesson hinges on the intent.

Detailed below are a series of training maxims that concisely speak to things one should (and shouldn't) do to improve athletic performance. While I doubt most will agree with every saying I am confident any coach, athlete, teacher or parent will find more wheat than chaff.

1. A limiting factor in athletic performance is not enough time. From start to finish (or at least significant decline) most athletic careers last 10-12 years. Some master competitors may go on forever but improved performance does not. This underscores the import of planned training and recovery efforts in order to optimize one's potential. Poor planning, a reckless lifestyle and haphazard efforts produce haphazard results. Time is of the essence.

Train with intention. If one's goal is improvement should not all one's efforts be directed to that end? Therefore one needs to critically evaluate the various components of a training plan (interval training, strength work, pre-hab efforts, biomotor skill development, etc.) to see if they are aiding or hindering one's training goals. Lifestyle also comes into play, therefore living with intention is a good idea too. This involves knowledge and forethought and the sense to reevaluate as necessary. Mindlessness has no focus. Don't just do it.

2. Speed is a function of strength. If one's goal is to run fast one needs to be strong. All top-level sprinters are powerful people. Power is defined as a combination of speed and strength. While various methods to strengthen the legs can be used (weights, hiking, long slow distance) strengthening the prime movers (gluts, quads, TFL, hamstrings, gastroc/soleus) is critical if one is to run faster. Weight training with a progressive overload is the safest and simplest way.

3. Psychological strength comes from psychological security. The "home court advantage" happens because prior to (and during) a competitive event one knows the venue, the registration procedures, travel times, and such simple creature comforts as where the water fountains and bathrooms are. The elimination of "surprises" that alter one's competitive focus needs to be minimized through planning and trouble shooting before the big day.

4. A limiting factor in athletic performance is energy/nutrition. Life is an endurance sport. The quality and length of our lives is directly affected by the quality of the food we ingest. In a competitive situation the depletion of the body's energy stores ("hitting the wall") has taken on mythic qualities. The expressions of speed, strength or endurance all hinge in part, on the fuel in the tank, our nutritional stockpile.

5. Nothing goes in your mouth by accident. The exception to this rule might be a bug or bee but past that—let's get real, Twinkies, drugs, alcohol or "more than enough" are the results of our willpower or lack thereof. Temptation can be answered by critically evaluating the object of one's desire and asking, "What part of my body do I want this to become?"

6. You are what you eat. How could this not be true? High salt, high sugar, processed foods loaded

By Russ Ebbets

with trans-fats do little for the body other than taste good and temporarily satisfy hunger. These fillers are empty calories that cannot be built upon. In the early days of computer programming there was a saying "garbage in-garbage out" and everyone came to know what that meant. It works for food too.

7. Vitamin supplementation is meant to enhance food, not replace it. In America we are enamored with pills. The pharmaceutical industry has a pill for every stage of one's life, for problems real and imagined. There is a tendency to believe that pills cure all ills. Processed foods, genetically engineered grains from heavily fertilized, devitalized ground produces devitalized foods. Vitamin supplementation can help make up for nutritional shortfalls. But one must still start with the highest quality fruits, vegetables and protein sources available.

8. Insecurity overprepares. Many people mistakenly equate "extra effort" with success. Whether it is one more set or rep or mile they reason that this extra effort is what will ultimately distinguish them from the competition. Often as not this extra effort leads to an overtraining situation, whether it is an illness or injury in the short run or significant breakdown and shortened career in the long run. This underscores the "train with intention" maxim. And if you live and die by the thought "good enough is never enough"—get some help.

9. Process precedes outcome. For the musician to complete a musical piece he must play a series of notes (or combinations of notes) in sequence. One sound follows another. When this is done with timing and coordination music is produced. From the unskilled we get noise. For an athlete to solely focus on the end goal without attention to refinement of the daily steps blurs focus of the here and now. Goals may offer direction but it is what one does at this moment that one can control. If the daily process is learned and done correctly a successful outcome should follow.

10. Practice what you can, not what you can't. If I were to tell you that I could change a Cadillac into a Rolls Royce by driving it faster you'd laugh at me. For that transformation to take place you'd have to change and improve the parts. To train physically as a four-minute miler when you are running 4:20's will only lead to frustration and injury. An honest evaluation of one's current fitness level is necessary. Perfect that process and then shoot for an incremental improvement. Success more often comes by approximation than with a fantastic leap.

11. Never create doubt. Doubt is a cancer of the mind. One of the things that distinguishes successful athletes from run of the mill ones is the unshakable belief that a goal can be accomplished. Part of that belief is the role the coach and important others (teammates, parents, teachers, etc.) play in creating an, "I can do this," environment. Necessarily part of this environment is the presentation or creation of challenges that (through process) are met and accomplished. This creates an inventory of success and a mindset on the part of the athlete that with preparation and diligent application the challenges can be successfully met. If sarcasm, cynicism and cutting remarks are mixed with unrealistic goals success or failure will be left to chance. When the first thought one faces with a challenge is, "I can do this," the battle is more than half won.

12. When training children—don't fatigue the system. For the child there is a fine line between growth and development and training and competition. While they both can happen simultaneously should one pair dominate it is to the detriment of the other. The reason one cannot do both is due to the limited energy reserves of the body. Childhood and adolescence are times that place significant energy demands on the body due to growth. If a child is highly trained or over competed energies that would go towards growth and development are shunted towards competitive survival. Allowing the child to transition through periods of fun (ages 6-11), commitment (ages 12-17) and performance (18+) offer a more natural progression that roughly parallels the mental and physical development stages to maturity. What constitutes system fatigue? Tudor Bompa has recommended 65% efforts, but that can be difficult to quantify. A simple clue to early fatigue is when the laughing stops and the hands go on the knees—workout done.

13. All things only grow once. Therefore, some believe, you should train the child hard from the start, let them get used to it and they will grow with it. This didn't work with the child labor tragedies of the 1800's so why would it work with athletic competition? What this maxim speaks to is the necessity of engraining fundamentals. These fundamentals could be movement patterns, thought patterns or problem solving skills. Engrained problem solving skills, behaviors and attitudes along with a progressive history of successfully meeting challenges creates within the young athlete an inventory of knowledge, skills and abilities that can be developed as one moves through the higher levels of competition. This value system, developed early on,

creates a self-support system when the inevitable setbacks, failures and frustrations of life stymie one's efforts. It is the strength of this value system that determines whether the obstacle is a stumbling block or a stepping stone.

14. The body adapts to the stresses placed upon it. This statement is true to a point. If the stress on the body faces is gradual and progressive the body will react by adapting with increased speed, strength or endurance. It becomes important that the training be focused to the task demands of the event or sport. To train a marathoner's vertical jumping ability would be a waste of time just as it would be wasted time to train a high jumper's ability to run a marathon. But with too much focused training without adequate recovery time the body will not adapt to training and overtraining, illness or injury will result. At the higher levels of training this is a fine line.

15. Train movements, not muscles. This a maxim attributed to training theorist Tudor Bompa. All sporting activities are a sequence of multiple movements with the timing and coordination of these movements critical for efficient technical execution, energy efficient movements and refinement of force application. Because of this resistance training (including weight training, medicine ball work, kettle bells, etc.) is most fruitful when the whole body, or at least major portions of the body are trained mimicking the movements of the technique or sport.

Bodybuilding exercises (biceps curls, seated leg extensions, calf raises, etc) may help with general fitness and develop aesthetic appeal but these isolated movements usually transfer poorly to a "whole action" like running, throwing or playing a position on a team.

The dynamic stabilizers are the exception to this rule. Dynamic stabilizers are muscles that stabilize joint complexes as we move. The glut medius, psoas, adductor group or posterior tibialis of the foreleg would be examples. These muscles warrant special attention, either prehab work or when injured, rehab work so they can successfully meet the demands they may face. Training movements, not muscles is a maxim true 80-90% of the time.

16. Flexibility should be optimized, not maximized. Flexibility is the only non-competitive biomotor skill. The problem with becoming too flexible is that it dampens the neuromuscular response of the body, which is another way of saying it dampens the body's speed and reaction time. Different activities will require different levels of flexibility, the hurdler versus the marathoner, yet both could become too flexible for their event. Freedom of range of motion within the technical demands of an activity is the goal; improvements past that point are wasted time and non-productive.

17. All growth and development comes while resting. If one were to run a hard 400m, rest 15 seconds and try it again—what would be the benefit? Probably very little. The recovery time was too short. In a competitive training situation one's recovery time should be as closely monitored as one's training. In fact there is a sub-maxim here—*recover as hard as you train.* When this process is carefully monitored optimal growth and development will result. To neglect, ignore or otherwise minimize the importance of adequate recovery courts illness, injury and systemic breakdown.

18. Maximal use is always abuse. Rich Phaigh, a massage therapist for Athletics West is credited with this statement. When one starts to move faster than 95% effort the coordination of the body starts to unravel. One needs to accept the fact that speed and speed actions represent the ultimate coordination of the body. Coordination is a pattern and maximal effort is by its very nature something that has not been done before; it is a new experience by the body and because the performance is "new" there is no pattern for it. The problem is that the body attempts to use old patterns to perform new actions that are uncoordinated and at least minimally damaging to the body, even though this is on a microscopic level. But repeated time and time again without proper recovery methods these microscopic injuries accumulate. The replacement scar tissue that forms, tears more easily and can lead to more serious, possibly career-ending injury. Age 35 seems to be the age where the "maximal use" of a career is no longer tolerated by the body. Coincidentally that is roughly the age most high level careers come to an end.

19. Fatigue is a defense mechanism of the body. When a car's energy system (gasoline) is depleted it stops. The depletion of energy stores in the body due to hard work—what marathoners call "hitting the wall"—signals the end of high intensity effort. When you are done, you're done. Take the hint, rest up and return to perform another day.

20. Training to failure is training to fail. In America our mythic sports heroes always give 110%. But do they really? Once fatigue has set in and there is a technique breakdown (rigor mortis, poorly controlled or coordinated movements) one is no longer training patterns that clarify neuromuscular response, coordinate force applica-

tion or maximize body efficiency. Practing with technical breakdown is practicing things one does not want to duplicate in a performance effort, and is often one step away from injury. Perfect practice makes perfect. Sometimes good enough is good enough. Let it go at that.

21. People are 80% water and water always takes the easiest course. An obsessive-compulsive person has it their way all day, every day, and they drive themselves and everybody else crazy. A person who works at 80% efficiency rate is seen as highly organized and somebody who can "get things done." The price of perfection is prohibitive. The difference between perfect and done is perfect is never done.

22. Basic body fitness begins at the core. The muscular stability of the abdomen and core muscles is critical for anyone wishing to run, jump or throw in a competitive circumstance. Planks, side planks, sit-ups and push-ups are simple exercises to get one started.

23. Training at the performance level is not a natural or healthy thing to do to your body. If you were an "average" person cruising the aisles of a local supermarket how apt would you be to run a marathon? Or perform a maximal bench press? Or run 10x400m in 80 seconds? Or do depth jumps or a plyometric routine? Not very likely. Maximal use is always abuse. Highly competitive efforts place abnormal stresses on the body. Over the course of time this damage accumulates with varying degrees of injury or illness. It is important one see this distinction between fitness and performance-based efforts where one strives for a personal best. The fitness activities can be used to build up the body. Performance-based efforts create a situation where damage to the body is the result of the maximal effort which underscores the importance of recovery effort.

24. Children are not little adults. One of the most difficult things I have ever had to write was the distance running curriculum for the USATF Youth Level II Coaching Education Program. I researched all the great distance coaches, in the world, and not one had anything to say about coaching the child distance runner. Ultimately I came up with four recommendations—keep it simple, keep it short, keep it fun and keep it fast. For the adult distance runner this would produce limited results, but who really cares about the performance results of a child? The performance marks a 10-year-old makes give little indication of future potential. Doubt this? Google the American or World Records for 10-year-olds in the mile, 5k, 10k, half-marathon and marathon. Not one of these kids had any success as an adult if they even continued to run that long.

Fundamental movement patterns, personal self-discipline, personal responsibility, a rudimentary idea of what practice is about and how to work with others are noble goals for entry level programs—for any sport. Children are not little adults—don't train them that way. Keep it simple, keep it short, keep it fast and keep it fun.

25. Either pre-hab or rehab. Pre-hab is a series of movement drills done at the beginning of a workout session. Pre-hab efforts could be part of a dynamic warm-up that could include things such as foot drills, skipping, high knees, etc. The point of pre-hab is to tone or condition the general body or focal areas of the body for the stresses one faces in running, jumping or throwing.

Rehab efforts are focused activities necessary to repair a breakdown of a specific body part, usually due to overuse. The problem with rehab efforts is that they require a disruption in the long-term training schedule. They represent down time, a holding pattern of no improvement. This time becomes problematic in that weeks, months or even years spent in this state steal time that could be used for development of one's potential. While rehab is critical to the ill or injured athlete it results from poor training plan design and in the grand scheme is wasted effort.

USATF High Performance Plan: Overview of New Sport Science Initiatives

At the beginning of each quadrennium, USA Track & Field presents a copy of a four-year High Performance Plan to the U.S. Olympic Committee for their consideration and support. As part of the 2013—2016 USATF High Performance Plan, five new sports science initiatives (broadly referred to below as the Initiatives), were introduced and outlined. Each of these proposed Initiatives are believed to carry the potential of a positive impact in medal production in 2016—either by increasing medal wins in event areas where the USA was lacking in 2012, or by defending medal winning event areas from 2012.

As a regular contribution to *Track Coach,* we will outline and update progress on these Initiatives, as well as additional aspects of the USATF High Performance Plan. It is hoped that this will allow the USATF community of coaches and supporters to have an understanding and an appreciation of the steps being taken by USATF and the USOC to utilize sport science and medicine resources to optimize performance and medal attainment.

This first report will introduce all five Initiatives and give the rationale behind our first Initiative, which focuses on the throwing events. In future editions of *Track Coach,* we will outline different Initiatives, and in late 2015 and early 2016, we will report on our efforts and final plans heading into the Olympic Games in Rio.

Broadly, the five new Initiatives include:

- Periodization and peaking for championship competition in the throwing events
- Critical performance factors and development in the horizontal jumps
- Proper timing of altitude training camps prior to major championship competition in the distance events
- Relationship between strength levels, strength training, and performance in the short sprint events
- Pacing, energy expenditure, and metabolic factors in the 400m dash and 400m hurdles

For each of the new Initiatives, we started in 2013 with Step 1 below—part of an overall three step approach:

Step 1: A meeting of a small and focused panel of experts, including sport scientists, coaches, athletes, and administrators, to define the problem, delineate "knowns and unknowns," and chart a direction for solving the problem.

Step 2: Information gathering, data collection, and pilot testing of interventions

Step 3: Development of recommendations, applied interven-

By Robert F. Chapman, PhD
Associate Director of Sport Science & Medicine, USA Track & Field

tions, teaching models, or other techniques and dissemination to coaches, athletes, and key personnel.

In 2014, we began to apply the recommendations of our working groups, and we hope to see the fruits of these labors in performances at the 2015 IAAF World Championships, en route to the 2016 Olympic Games. Below are brief excerpts from the USATF High Performance Plan, with rationale and specifics for each of the five new sports science Initiatives.

2013—2016 SPORT SCIENCE INITIATIVE #1—PERIODIZATION AND PEAKING FOR CHAMPIONSHIP COMPETITION IN THE THROWING EVENTS

Certainly for all events, a key factor in medal winning performances is achieving peak performance at the Olympic Games or World Championships. In some cases, the nature of our Olympic Trials/U.S. Championships qualifying system makes periodizing training for the Games or Worlds difficult. Athletes need to find a way to have a high level of performance at the Olympic Trials, and in many cases, they will need to be at their peak just to make the team. Between the Olympic Trials and the Games, athletes and their coaches will need to find a way to train, participate in competitions (both for development, readiness, and financial considerations), and re-peak at for the Games.

It is a very challenging proposition, one that the data suggests that our throwers have not completely mastered. One simple metric by which to analyze this is comparing the number of athletes who had performances at the Olympic Games that exceeded the marks they achieved at the Olympic Trials, just weeks earlier.

Looking at the last three World majors (2011 and 2013 IAAF World Outdoor Championships and the 2012 Olympic Games), below are the data (Table 1).

Of the 23 athletes who made the US Olympic team in the throwing events, only 13% threw further at the Games than at the Olympic Trials about five weeks earlier. For comparison, 63% of the US sprint / hurdle athletes and 29% of the US jumps athletes performed better at the Olympic Games vs. the Olympic Trials. Note that the distance events are excluded from the above analysis due to the strategic nature of pacing in championship racing—the analysis simply isn't valid for the distance events.

We further examined the results of all of the non-US athletes who made the final of the Olympic Games in the throwing events. In total, 52 of 86 (60%) threw farther at the final of the Olympic Games than they did in the entire month of June (a time-frame analogous to our US Olympic Trials). These data suggest that this issue of timing of peak performance in the throwing events is much less of an issue for international throws athletes, likely due to the nature of committee or federation based team selection in other countries.

There are a number of possible explanations for this result, and a few that can likely be discounted rather quickly. For example, differences in weather conditions (particularly temperature and wind) could account for differences in performance between the two sites. However, the weather conditions in Eugene and London, by all accounts, were quite similar. Secondly, from a psychological perspective, one could hypothesize that if our throwers were not experienced in international championships competition, they might perform worse at the Games. However, of the 23 U.S. Olympic throwers, 17 had made at least one previous World Championships or Olympic team. Arguably, it was one of—if not the most—experienced throws squads in Olympic history.

What then are possible explanations for the lack of "peak" performances by U.S. throwers in recent Olympic (and World Championship) competition? Below are a few possible reasons:

Table 1

Year	Number of throws athletes on the US team	Number of US athletes who threw farther at the OG/WC than at OT/US Champs	Number of US throws medals	Number of days between OT/ USA Champs and OG/WC
2011	21	4	1	62
2012	23	3	1	33
2013	17	0	1	48

Note that in 2013, if our World Championships team throwers would have simply thrown the same distance in Moscow that they did about 7 weeks earlier at the USA Championships in Des Moines, we would have won *five* medals instead of zero.

- Differences in taper/peak/re-peak physiology for the explosive throwing events, compared to the sprint, endurance, jump events.

If unique differences do exist for the throws regarding tapering and peaking, what are the factors involved and can they be modified with altered training approaches between the Trials and Games? It is not unreasonable to assume that the physiology of timing regarding taper for the Olympic Trials, then training and re-peaking for the Games would be different between events requiring different energy systems and motor recruitment patterns. If so, we could even ask if USATF should consider changes in the timing of the Trials events for the throws, in order to give these athletes the best "physiological window" in which to perform at a peak in the Trials and Games. Note that this altered window could be shorter or longer than the current timeframe used.

- Logistics of Olympics / Worlds qualifying in the throwing events

Some of our throwing events, like the men's shot put, will have a large number of athletes with the Olympic / World A qualifying standard, making the Trials highly competitive. These athletes will have to be at their peak at the Trials to have an opportunity to make the team. However, in many of our throwing events, simply achieving the A standard in the qualifying window will practically assure the athlete of making the World or Olympic team. For example, the men's javelin had only three athletes with the A standard prior to the 2012 Olympic Trials. The men's discus only had four athletes with the A standard, and the men's hammer just two athletes with the A standard prior to the Trials. The women's events were similar with the number of athletes with the A standard prior to the trials (shot put, five; discus, three; hammer, three; javelin, two). In these events, many athletes will spend the spring of 2015 and 2016 "chasing" the qualifying standard. In theory, some of these athletes may achieve the standard, but not necessarily be at their peak for the Trials—yet may still make the Olympic Team if three or fewer athletes are qualified.

- The dynamic of World/Olympic warm-up procedures and preliminaries structure

The warm-up procedures for the throwing events at the World Championships and Olympic Games are different from pretty much every domestic U.S. competition. For example, at the Olympics, athletes are generally allowed to warm up as they desire at the warm-up track. Following a (sometimes long) walk to the call room, athletes can be sequestered, unable to throw for as long as 45 minutes. Once marched to the track, athletes are commonly given a maximum of two warm-up throws in the competition circle/runway before the event starts. Furthermore, it is not uncommon to have fields of up to 20 athletes in the preliminary round. With all too frequent delays due to things like medal awards ceremonies or the start of sprint races where quiet is deemed necessary, it can be 30 minutes or more between throws. Finally, coaches are placed sometimes a great distance away in the stands, making communication concerning technical matters difficult.

Needing to produce a top 12 mark with just three available attempts in these conditions is a challenge, made even more difficult for U.S. athletes considering that no U.S. competitions use these warm-up procedures. In the U.S., throwers are commonly given as many warm-up attempts as they desire. Coaches are often either ringside or within shouting distance. With rare exceptions, U.S. meets do not have a three-throw qualifying round, and morning preliminaries/evening finals are typically seen only at the Olympic Trials. From an experience and even a motor learning standpoint, a lack of familiarity of competing in this environment, under the unique Olympic warm-up logistics, leaves our throws athletes less than ideally prepared to perform.

- The financial nature of training vs. competition prize money for throws athletes.

For most of our top throwers, financial livelihood through track and field is going to come mainly through competition prize money, with a few being able to earn an income through a contract with a sponsor. Even then, in the throwing events, often the contract dollars are incentivized heavily through a bonus structure based on performance at major championships (Olympics and World Championships). As a result, some throws athletes are faced with decisions regarding training versus competing, in the window prior to a major championship. See an explanation of this thought process below, from a blog post made after the 2011 World Championships by men's shot put athlete Adam Nelson:

> "[The] U.S. system rewards results only. Hence, our training and competition plans have to balance our cash flow needs throughout the year. So

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USA TRACK&FIELD

COACHING EDUCATION SCHOOLS—2015

For registration information on these schools, see the USATF website, www.usatf.org and click on RESOURCES FOR…, then click on COACHES. A menu on the left-hand side includes "Calendar of Schools"; click on that to get the pertinent information for each school.

LEVEL 1 COURSES

January 1-5	Drury Inn, La Cantera—San Antonio, TX
January 17-18	Marshfield High School—Coos Bay, OR
January 17-18	Chabot College—Hayward, CA
January 23-25	Episcopal High School—Alexandria, VA
January 30 - February 1	Boise High School—Boise, ID
February 7-8	Maryvale High School—Phoenix, AZ
February 13-15	Benedictine University—Lisle, IL
February 14-15	Orange Coast College—Costa Mesa, CA
February 20-21	Drury Inn St. Louis—Creve Coeur, MO
February 20-22	University of Portland—Portland, OR
February 21-22	Sandia Preparatory School—Albuquerque, NM
February 27-28	Houston Baptist University—Houston, TX
March 6-8	St. Martin's University—Lacey, WA
June 26-28	New Hampstead High School—Savannah, GA
July 17-19	Nassau Community College—Garden City, NY

LEVEL 3 COURSES

Ongoing	Online Advanced Training Theory Course
January 17-18	The Speed Summit Southwest at Southern Methodist University—Dallas, TX

LEVEL 1 PROGRAM

The Level 1 course is the cornerstone of the USATF Coaching Education Program. It establishes a common ground amongst coaches by developing a language specific to the track and field coaching community. The program covers all events in a straightforward manner by emphasizing fundamentals, rules, safety/risk management, and instruction techniques. Certified by the National Council for Accreditation of Coaching Education (NCACE), the course prepares an individual to coach at the junior high school, high school, club, and junior age division level.

Course Structure

The cost for a Level 1 school is $150.00 for early-registration or $200.00 after the early-registration deadline. Schools are typically two-and-a-half-day courses where 21.5 hours are spent on track & field and related sport science. The course consists of classroom instruction as well as hands-on training.

After the school, **participants have 90 days** to complete the online exam which covers event-related and sport science subjects. Upon passing the exam participants will be able to download a Level 1 Certificate.

Requirements

To attend a Level 1 School a coach must:

- Be at least 18 years of age
- Have a current USATF membership

Registration

1. Become a USATF Member
2. Locate a school
3. Complete the online registration process (visit the Coaching Education Calendar and select "Registration Information" for the school you want to attend)

Benefits

- Recognition as a USATF Level 1 Coach
- Curriculum book covering sport science and individual events
- Skills and knowledge to coach athletes at all levels
- Access to instructors and mentors with extensive experience
- Eligibility to attend a Level 2 School (Must have completed Level 1 no later than April 30th of the year prior to the Level 2 School for which you are applying)

USATF High Performance Plan: Overview of New Sport Science Initiatives

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you have a choice: Train for the major championships or schedule your training around the Diamond League series and our U.S. National meet. The first is an all-in bet that you will perform at the majors to make up for the missed income opportunities throughout the year. The second is "safe" plan that at least insures a bit of cash flow throughout the year and almost guarantees less than optimal performance at the majors.

Side note: If I won Worlds, I would have netted $160k in prize money and bonuses over the next year. If I win all the diamond league meets, I'd make about the same. If I place 4th at worlds, that number drops to $15,000. If I place 4th at all of the Diamond League meets, I make $21,000. We don't receive bonuses for placing below 3rd. Diamond League meets only pay prize money. So I have two scenarios: make a lot of money or make below poverty money.

What about sponsorships? Sponsors help a little, but only if you win. My base sponsorship package covers less than half of my monthly expenses. U.S. throwers don't receive large base contracts. We get paid for performing."

Answering each of these questions and solving the problem will require input from multiple sources: muscle physiologists, strength training experts, motor control/learning specialists, podium level throws coaches, coaching education specialists, USATF /USOC administrators, and athletes. In future editions of *Track Coach,* we will update readers on our progress in developing solutions. Next issue, we will highlight our new sport science Initiative focused on optimizing altitude training responses in distance athletes.

2014 - 2015 OTC Chula Vista Coach's Corner

As we started the 2014-2015 track season we made a few changes at the Olympic Training Center-Chula Vista. Long time BYU and current head coach Craig Poole retired from the OTC and we hired Kris Mack from the University of Cincinnati to replace him and coach the pole vault and multi events. I took over as lead coach and program manager of the residence program here at the OTC as we move into the World Championship and Olympic years of 2015 and 2016. The coaches who currently work with the athletes here are our regular coaches: Mac Wilkins, Art Venegas, Al Joyner, and Joaquim Cruz.

In regard to athletes we added a very successful and bright group: Mason Finley (Wyoming) and Andrew Evans (Kentucky) in the discus; Richard Garrett (UTSA) in the shot put, Rickey Robertson (Mississippi) in the high jump; 2012 Olympian Cyrus Hostetler (Oregon) in the javelin; NCAA long jump record holder Whitney Gipson (TCU); and 2013 World Championship team member Brandon Johnson (UCLA) in the 800m.

A recap of last year,s season was one for the record books for the OTC group. Indoors Tyron Stewart won his first U.S. championship in the long jump, jumping 8.22m. We had top 5 finishes by Chris Benard 2nd LJ and TJ, Troy Doris 3rd TJ, Joe Kovacs 3rd Shot, Tia Brooks 5th Shot, Jeff Henderson 4th LJ, and Kiani Profit 5th Heptathlon.

Outdoors we continued the success from indoors as Joe Kovacs, Will Claye, and Jeff Henderson all won their first U.S. titles in the Shot Put, Triple Jump, and Long Jump. All three athletes also set lifetime best in securing their wins. Brittney Reese added to her resume as she won her 6th outdoor title in the long jump. Sean Furey secured his second title in the javelin, winning the U.S. championship to go along with the one he won in Des Moines 4 years earlier. By the end of the year we had 11 athletes finish with top 20 marks in the world and two rank number one in their respective events.

Looking toward the 2015 season we really are excited about the progress the athletes are making. We've had a great fall finding unique and various training methods as Beynon was resurfacing our track. With Worlds in late August the mix of dirt hills, grass runs, sand jumping, sand running, and stadium steps have been a great alternative to training and training creativity.

Sincerely Yours in Athletics,
Jeremy Fischer

By Jeremy Fischer

TRACK TECHNIQUE/ TRACK COACH CONTENTS

TRACK TECHNIQUE/TRACK COACH BACK ISSUES. The issues listed below are the only remaining issues of the printed issues. If an issue is not listed, it is out of print and unavailable. These issues are available singly for $5.50 apiece postage-paid for U.S. delivery; $8.00 apiece postage-paid for foreign delivery. Order 5-9 issues, pay $4.00 apiece; more than 10 issues, $3.00 each, postage-paid. Non-U.S. orders—add $2.00 shipping per copy. Some issues are in short supply, so order early. Visa/MC/Amex orders accepted by phone: 650/948-8188 9 am-5 pm PT, M-F. Note: The periodical's name was changed from *Track Technique* to *Track Coach* with issue #131 (Spring 1995). Listed below are a few of the more prominent articles in each issue. There are many more useful contributions in each number.

A one-year DIGITAL subscription (four issues) is $20 U.S. and foreign. *Effective with our Winter 2015 Issue #210, Track Coach will be available by electronic format only. Digital issues will be sent to the email address used for placing your order.* **Order from:** Track & Field News, 2570 W. El Camino Real, Suite 220, Mountain View, CA 94040 USA. Email: subs@trackandfieldnews.com.

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